General Atomics

Destruction Technology Demonstration For Organics In Transuranic Waste

Technology Need:

Incineration, long a remediation technology of choice, is now viewed more frequently than not as a nonoption due to intervention by public interest groups. This has led the DOE to exit the incineration business and initiate the search for nonincineration alternatives. General Atomics is focusing on a batch process for 55-gallon drums of mixed transuranic waste at the Savannah River Site (SRS). SRS is required, by the NRC, to select a treatment method for disposal of the drums of mixed transuranic waste by 2003.

Technology Description:

General Atomics (GA) proposes a two-step alternative to incineration for the destruction of organics in transuranic wastes at the Savannah River Site. GA combines two well-known and effective treatment processes, thermal desorption (TD) and supercritical water oxidation (SCWO), to achieve enhancements not possible with either technology alone, or with other potentially competitive technologies.

TD is well established as a treatment process for removal of organics from difficult solid matrices such as soils and mixed wastes. Steam and heat are used to volatilize, gasify and transport organics from the inorganic residue for subsequent treatment. SCWO is a well-developed nonincineration process for destruction of organics in pumpable forms such as liquids and slurries of finely divided particles. SCWO oxidizes organics in an aqueous medium at elevated temperatures and pressures in a manner that achieves excellent destruction efficiencies and compliance with all environmental requirements without the need for complex pollution-abatement equipment. GA combines these processes to achieve complete removal and destruction of organics from solid matrices with minimum pretreatment and posttreatment requirements.

The integrated TD-SCWO process overcomes two fundamental problems, one related to TD and the other to SCWO. Traditionally, TD generally requires an afterburner and a complex pollution-abatement system (PAS) to destroy the desorbed organics, thus violating the nonincineration objective and compromising permitting and public acceptance. Additionally, the afterburner increases the likelihood of dioxin formation. For the SRS application, the spread of Pu-238 contamination throughout the afterburner and PAS further compromises traditional TD technology. Traditionally, SCWO feed materials must be liquids or finely ground solids that can be slurried and pumped to high pressure. With TD-SCWO, however, TD desorbs organics from any form of solids and delivers the gas-phase organics to SCWO, thus resolving the feed pretreatment requirements of SCWO. In turn, SCWO resolves the afterburner/PAS requirements of TD by destroying the organics at SCWO conditions and capturing particulates, acids, and any other pollutants in the liquid effluent, and avoiding dioxin formation by rapid quench at the reactor outlet.

Integration of TD and SCWO subsystems is accomplished by operating at pressures of about 500 psig, retaining the advantages of SCWO and containing bulk solids in the pressurized TD. For the SRS application, a 55-gallon drum batch system is favored initially to minimize pretreatment requirements and the potential spread of Pu-238 contamination.

Benefits:

- Lower Life Cycle Costs (LCCs). TD-SCWO requires less gas treatment technology, is compact, reduces carryover of Pu-238 from the batch TD to SCWO, and

has compared favorably in LCC analyses with incineration for nonradioactive applications.

▸Lower Health and Safety Risks to the Worker and the Public. TD-SCWO is a sealed, pressurized system with the pressurized components enclosed by secondary containment and vented through HEPA filters and activated carbon.

▸Lower Risks for Detrimental Impact to the Environment. TD-SCWO is an inherently clean process that eliminates the conditions that lead to *de novo* synthesis of dioxins or furans.

▸Reduced Quantity of Waste Materials Requiring Disposal. TD-SCWO will densify the wastes allowing repackaging into fewer drums for transport to WIPP.

▸Reduced Hazard Level and Category of Waste. TD-SCWO will efficiently destroy organics, retain metals (except mercury) and radionuclides in the bulk desorbed waste, and retain mercury on the sulfur-impregnated activated carbon.

▸Possesses Ability to Meet Regulatory Requirements. TD-SCWO meets all regulatory criteria under the Clean Air Maximum Achievable Control Technology (MACT) rules.

Status and Accomplishments:

The project was initiated in September 2001. The objective is to demonstrate the ability of Thermal Desorption - Supercritical Water Oxidation (TD-SCWO), to remove hydrogen from surrogate hydrogenous waste streams. The surrogate waste matrix will be representative of Savannah River Site transuranic mixed wastes.

All 3 surrogate recipes have now been tested on the TD unit, with residual hydrogen typically in the range of 1 wt%. The residual mass is typically about ½ to 1/3 of the starting mass. Thus, based on the original mass, the hydrogen residual is in the range of 0.5 wt%. This quantity of hydrogen meets the criterion “less than 5 wt% hydrogenous organic” if the hydrogenous organic is assumed to be polyethylene.

Final cold demonstration will be performed late September 2002, at the contractor's facility in San Diego, CA. Based on the results of the demonstration, the contractor will perform economic studies and provide a conceptual design of the proposed 1/5th size of the commercial plant.

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Online Resources:

Office of Science and Technology, Technology Management System (TMS), Tech ID # 3158
http://ost.em.doe.gov/tms

The National Energy Technology Laboratory Internet address is http://www.netl.doe.gov

For additional information, please visit the General Atomics website http://www.ga.com/